

Aquifer Storage and Recovery an OASIS

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ASR - A Water Storage Strategy

- **The ASR Goal:**
 - Capture usable excess water and detain it underground for later beneficial use.
- **The ASR Purpose:**
 - Optimize multiple water sources to meet a variety of water needs at minimal costs.
 - AKA: Conjunctive Management

How is ASR Accomplished?

- **The Resources:**

- Surface water to Groundwater
- Storm water to Groundwater
- Groundwater to Groundwater
- Reclaimed water to Groundwater

- **The Tools:**

- Direct Injection, Wells
- Surface Spreading, Irrigation or ponding
- Infiltration, sub-surface percolation
- “In-lieu”, water exchanges
- Recovery by Wells - Typically

The Need for ASR

- Growing Demand
- Limited Existing Resources
- Environmental Restoration
- Drought Protection
- Temporal Shift in Available Water

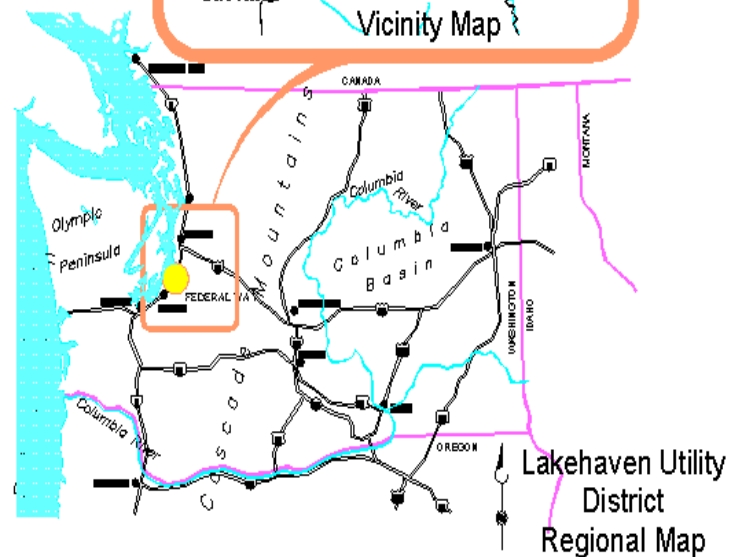
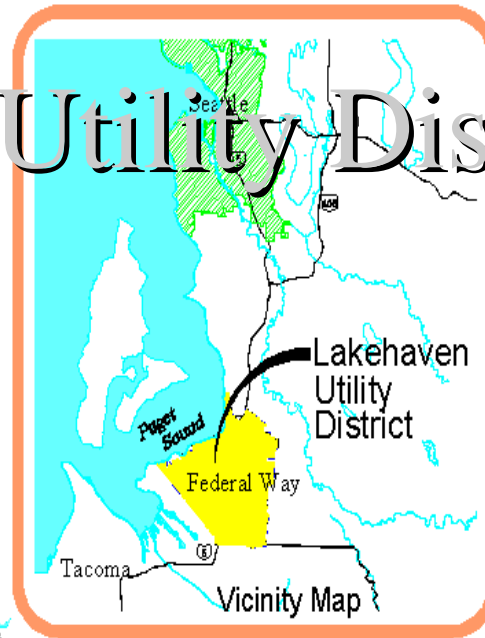
Benefits of Aquifer Storage

- Natural Storage Facilities
- Reduced Land Surface Impacts
- No loss of Environmental Habitat
- No Evaporation
- Protection from Surface Contaminates
- Proven Viable in Other States
- Cost Effective Peaking Capacity and Emergency Supply
- Ability to Maximize Existing Supplies (potable and environmental needs)
- Phasing

Concerns about ASR

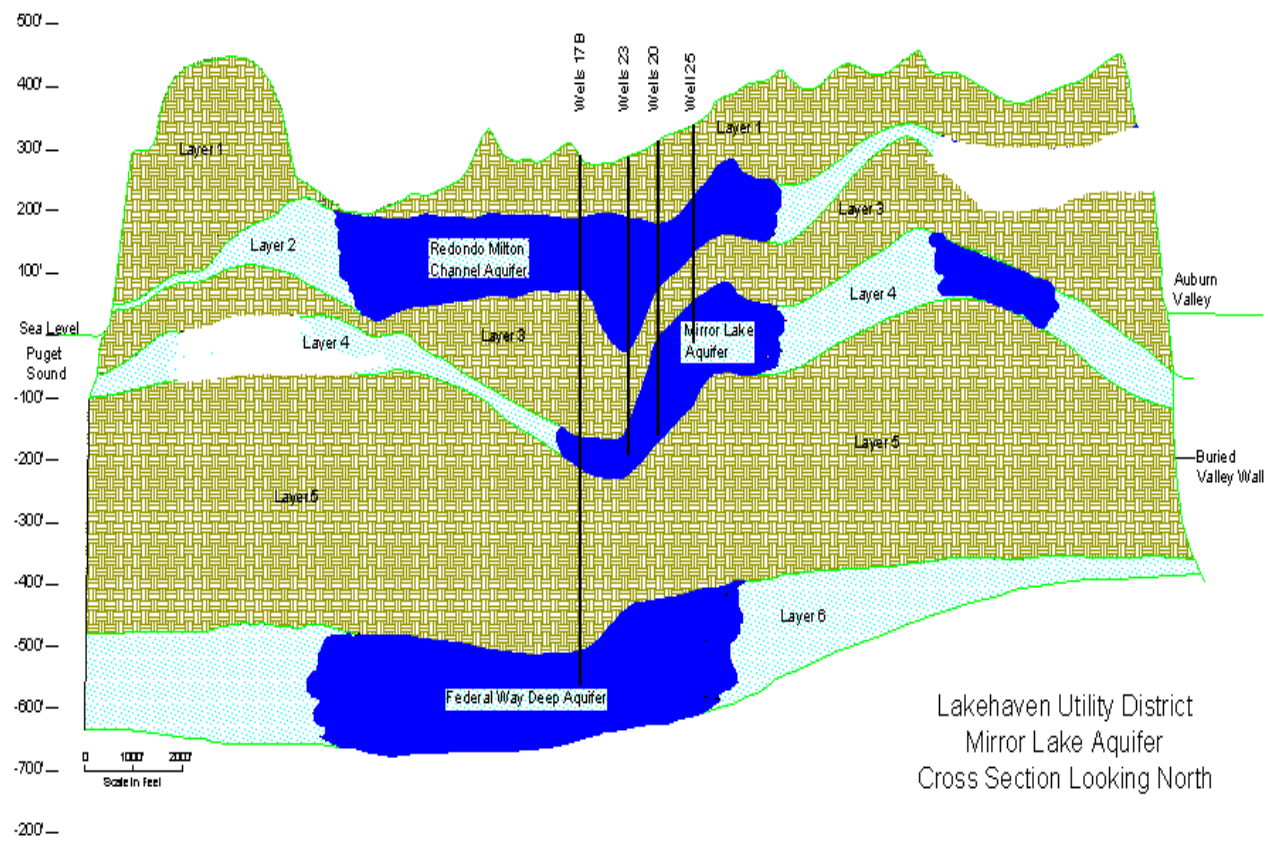
- “Newness of the Concept”
- Undefined Rules
 - operationally
 - Management
- Groundwater degradation
- Water Right Uncertainties
- Private Property Use
- Potential for Environmental Degradation

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Federal Way Aquifer System

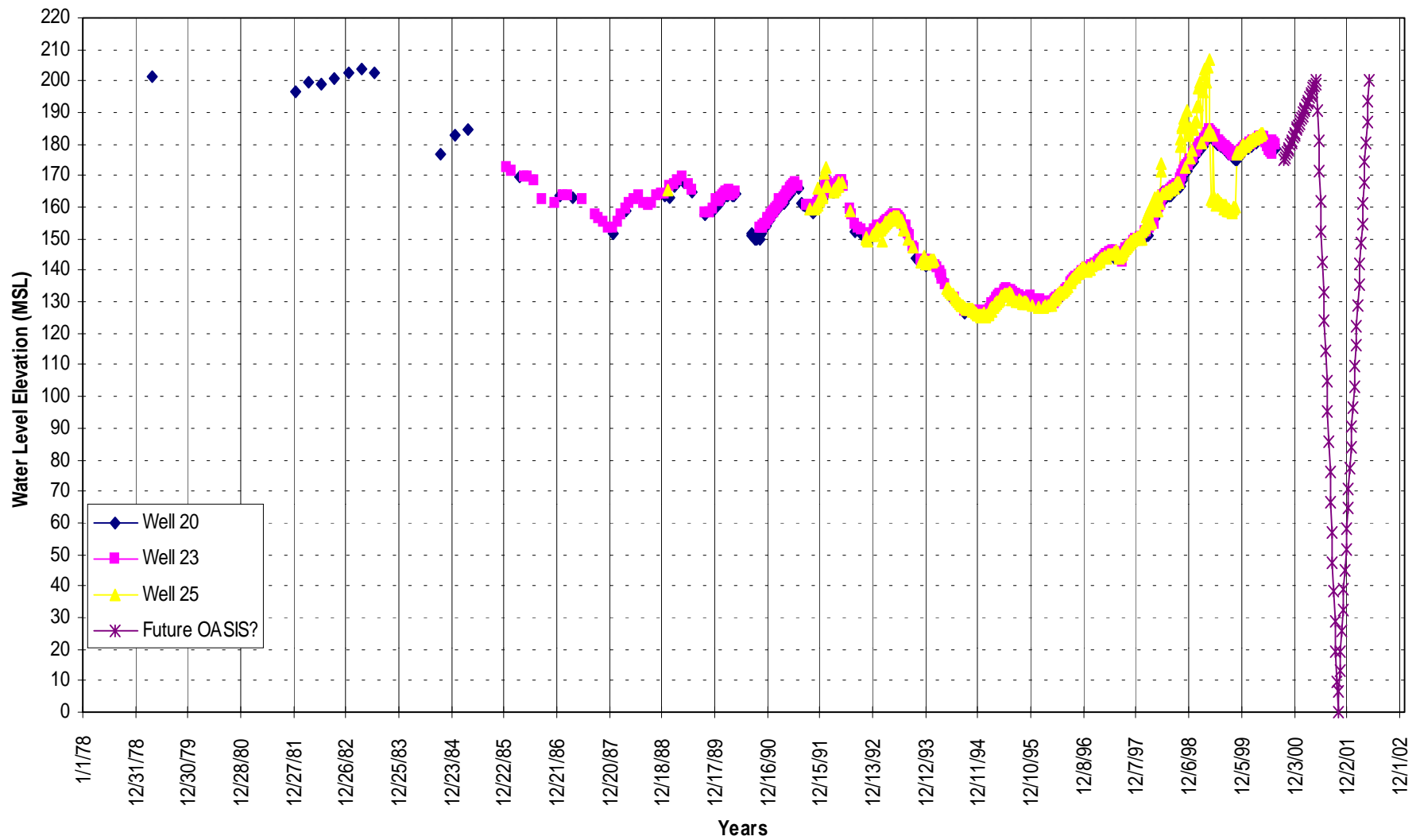
- Redondo Milton Channel Aquifer
- Mirror Lake Aquifer
- Federal Way Deep Aquifer
- Eastern Upland Aquifers



Lakehaven's OASIS

- **OASIS - Optimization of Aquifer Storage for Increased Supply**
- **History**
 - Located the Mirror Lake Aquifer in 1979
 - First Well began production in 1981 (3000 gpm)
 - Second Well began production in 1984 (1500gpm)
 - ASR Well Drilled in 1989 (Well 25)
 - 1992 Field test at Well 25
 - 1994 OASIS Feasibility Report

MLA Water Level Elevations

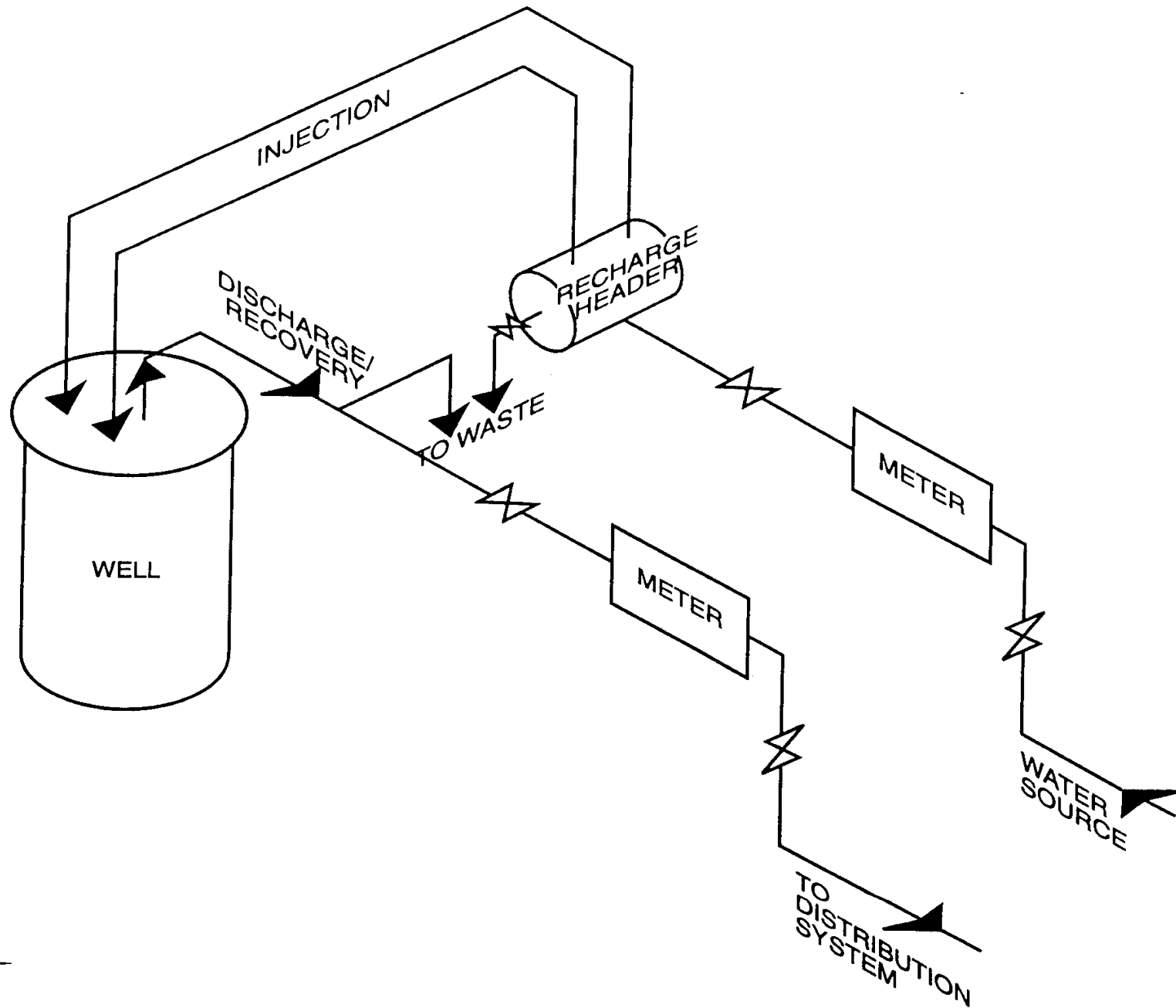


Finding of 1992 Study

- Tested Well 25 as an ASR Well
- Groundwater (RMC) to Groundwater (MLA)
- High Permeability
- Geologically confined by low permeability units
- Operationally feasible
- Adequate to accommodate long term injection operation

Well 25 Pump House Facility





1994 Feasibility Study of OASIS

- **Computer Modeling of MLA**
 - 29,000 acre-feet of Storage (9.5 billion gallons)
- **Water Quality and Geotechnical Issues**
 - Surface water to Groundwater
- **Operations and Infrastructure**
 - Local and Regional Facilities
- **Regulator and Environmental Issues**
 - Permitting
- **Management Options**
 - Evaluated Local and Regional Use of MLA

Feasibility Conclusions

- Low vulnerability to surface contamination
- Low risk of Subsidence (air vents)
- Water Treatment likely
- Need resolution of Water Rights Issues
- Need Regional Transmission
- 29,000 AF Capacity, ~27 wells @2000 gpm
- Cost Effective (~\$2 to \$4 Million per Well)
- No Fatal Flaws - But additional Field Studies

Operational Challenges

- Access to Excess Winter Water
- Source Water Compatibility
- Rates of Injection/Recover
- Contamination/Plugging/Air
- Land Surface Monitoring
- Redistribution

Administrative Challenges

- **Permitting - ESHB 2867**
- **Water Rights**
- **Private Property Use**
- **Land acquisition**
- **Management**
 - **True Available Storage**
 - **Staging and Costs**

Current Status

- LUD applied for Reservoir Permit under ESHB 2867
- DOE Starting Rule Making Process For Permitting
- Mirror Lake Aquifer is “Full”
- LUD pursuing addition Exploratory/Monitoring Wells
- LUD/Tacoma Completed Significant Transmission Facilities